INDOOR AIR QUALITY ASSESSMENT

Massachusetts Department of Mental Retardation
Hogan Regional Center, 2 Hathorne Circle
Village of Hathorne, Danvers, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Center for Environmental Health
Bureau of Environmental Health Assessment
Emergency Response/Indoor Air Quality Program
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Background/Introduction

At the request of Linda Montminy, Facilities Director for the Massachusetts Department of Mental Retardation (MDMR), Hogan Regional Center (HRC), the Massachusetts Department of Public Health (MDPH), Center for Environmental Health (CEH), Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air quality concerns at the HRC, 2 Hathorne Circle, Village of Hathorne, Danvers, Massachusetts.

Concerns of microbial growth in the basement prompted the request. These issues were addressed in a separate letter dated August 10, 2004, provided by BEHA, which is attached as Appendix A. On July 7, 2004, a visit to conduct an indoor air quality assessment was made to this building by Cory Holmes, Environmental Analyst of BEHA's Emergency Response/Indoor Air Quality (ER/IAQ) Program. Mr. Holmes was accompanied by Robert Hyde, Director of Core Services, HRC.

Two Hathorne Circle is a two-story brick building with basement constructed in the late 1960's. The HRC contains patient units, dorm rooms, nurses' stations and administrative offices.

Methods

BEHA staff conducted a visual inspection for standing water, water-damaged building materials and microbial growth. Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551.

Results

The building has an employee population of approximately 115 individuals, with a resident population of approximately 35. Tests within the building were taken under normal operating conditions. Test results appear in Table 1.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were above 800 parts per million (ppm) in six of fifteen areas surveyed throughout the building, indicating inadequate air exchange in some of the areas surveyed. It is also important to note that areas with carbon dioxide levels below 800 ppm were sparsely populated, unoccupied and/or had windows open, which can greatly reduce carbon dioxide levels. Carbon dioxide levels would be expected to be higher with increased occupancy during the heating season when exterior doors and windows are shut.

Fresh air is supplied by a unit ventilator (univent) system (Picture 1). Univents draw air from outdoors through a fresh air intake located on the exterior walls of the building (Pictures 2 and 3) and return air through an air intake located at the base of each unit (Figure 1). Fresh and return air are mixed, filtered, heated and provided through an air diffuser located in the top of the unit. The majority of univents were not operating during the assessment. Therefore, no mechanical means of introducing fresh air were being provided. In order for univents to provide fresh air as designed, they must remain operating while rooms are occupied.

Exhaust ventilation consists of wall or ceiling-mounted vents (Pictures 4 and 5) powered by rooftop motors. The exhaust system was not drawing in a number of areas surveyed, indicating that motors had been deactivated or were non-functional. To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of occupancy. Without a means for air exchange via the mechanical supply and exhaust system, normally occurring indoor environmental pollutants (e.g. ozone from photocopiers, odors from cleaning products) can build up and lead to indoor air quality/comfort complaints.

In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. It is recommended that HVAC systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994). The date of the last balancing of these systems was not available at the time of the assessment.

Single dorm rooms are not equipped with mechanical ventilation. Instead, fresh air is provided by open windows. In a number of cases, openable windows have been eliminated with the permanent installation of window-mounted air conditioners. However, the air conditioners are equipped with a “fan only” or “exhaust open” setting (Picture 6). When operating in either mode, air conditioning units can provide air circulation by delivering outside air without cooling (i.e., air provided by unit equals that of outside temperature).

The Massachusetts Building Code requires a minimum ventilation rate of 20 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows <u>in each room</u> (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information on carbon dioxide see Appendix B.

Temperature readings ranged from 70^o F to 79^o F, which were within the BEHA recommended comfort range, with the exception of the break room. The BEHA recommends that indoor air temperatures be maintained in a range of 70^o F to 78^o F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. It is also difficult to control temperature and maintain comfort without operating the ventilation equipment as designed (e.g., univents and exhaust vents deactivated/not operating).

Relative humidity measurements ranged from 41 to 62 percent, which were slightly above the BEHA recommended comfort range in some areas. The BEHA recommends a comfort range of 40 to 60 percent for indoor air relative humidity. During the heating season, relative humidity levels would be expected to drop below the recommended comfort range. The sensation of dryness and irritation is common in a low relative humidity environment. For buildings in New England, periods of low relative humidity during the winter are often unavoidable.

Microbial/Moisture Concerns

As discussed, the assessment was requested due to mold concerns in the basement (mainly in the storage room), which were discussed in a previous letter (MDPH, 2004). Several other conditions that can lead to possible mold growth were identified. The mechanical room is used for storage of univent filters. A number of the cardboard boxes containing filters for the univent system appeared water damaged (Pictures 7 and 8). The US Environmental Protection Agency (USEPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommend that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Water-damaged porous materials cannot be adequately cleaned to remove mold growth. The application of a mildewcide to moldy porous materials is not recommended.

Trees and shrubbery were also noted outside the building in close proximity to exterior brickwork (Picture 9). The growth of roots against the exterior walls can bring moisture in contact with wall brick and eventually lead to cracks and/or fissures in the foundation below ground level. Over time, this process can undermine the integrity of the building envelope and provide a means of water entry into the building through capillary action through foundation concrete and masonry (Lstiburek & Brennan, 2001).

Other Concerns

In an effort to reduce noise, tennis balls had been sliced open and placed on walker legs (Picture 10). Tennis balls are made of a number of materials that are a source of respiratory irritation. Constant wearing of tennis balls can produce fibers and cause TVOCs to off-gas. Tennis balls are made with a natural rubber latex bladder, which becomes abraded when used as a leg pad. Use of tennis balls in this manner may introduce latex dust into the environment. Some individuals are highly allergic to latex (e.g., spina bifida patients) (SBAA, 2001). It is recommended that the use of materials containing latex be limited in buildings to reduce the likelihood of symptoms in sensitive individuals (NIOSH, 1997). A question and answer sheet concerning latex allergy is attached as Appendix C (NIOSH, 1998).

The laundry/dryer room is equipped with local exhaust fans to remove excess heat and moisture from laundry equipment. However, occupants reported that they are seldom used due to excessive noise. Without proper exhaust ventilation, heat, moisture and particulates can build-up and lead to IAQ/comfort complaints.

Finally, a snow blower was stored near the univent air intake for the clinical office (Picture 11). The close proximity of the snow blower to the air intake can result in fuel odors being entrained (drawn in) by the ventilation system and distributed to occupied areas.

Conclusions/Recommendations

In view of the findings at the time of the assessment, the following recommendations are made:

1. Implement recommendations listed in the previous BEHA letter regarding mold remediation in the basement storage room (MDPH, 2004).
2. Survey univents to ascertain function and determine whether an adequate air supply exists for each room. Consider consulting a heating, ventilation and air conditioning (HVAC) engineer concerning the calibration of univent fresh air control dampers throughout the building.
3. Operate all ventilation systems throughout the building continuously during periods of occupancy. To increase airflow set univent controls to "high".
4. Inspect rooftop exhaust motors and belts for proper function, repair and replace as necessary.
5. Operate air conditioners in rooms without openable windows in the "Fan Only" setting to introduce outside air.
6. Consider balancing mechanical ventilation systems every 5 years, as recommended by ventilation industrial standards (SMACNA, 1994).

7. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
8. Discard water damaged cardboard boxes and filters in mechanical room. Disinfect any areas of microbial growth with a one in ten bleach in water solution; wipe clean surfaces with soap and water after disinfection.
9. Remove foliage to a minimum of five feet away from the exterior of the building. Trim trees that overhang the roof.
10. Operate local exhaust ventilation in laundry room. Consider installing a variable speed dial to control fan speed/noise.
11. Change/clean filters for univents and air conditioning units as per the manufacturer's instructions or more frequently if needed.
12. Consider discontinuing the use of tennis balls on walker legs to prevent latex dust generation. Alternative "glides" can commonly be purchased from office supply stores, see Picture 12 for an example.
13. Relocate snow blower from vicinity of fresh air intakes.
14. Consult "Mold Remediation in Schools and Commercial Buildings" published by the US EPA (2001) for further information on mold. Copies of this document can be downloaded from the US EPA website at: http://www.epa.gov/iaq/molds/mold_remediation.html.

15. Refer to resource manuals and other related indoor air quality documents for further building-wide evaluations and advice on maintaining public buildings. These materials are located on the MDPH's website at http://www.state.ma.us/dph/beha/iaq/iaqhome.htm.

References

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US EPA. 2001. "Mold Remediation in Schools and Commercial Buildings". Office of Air and Radiation, Indoor Environments Division, Washington, DC. EPA 402-K-01-001. March 2001. Available at: http://www.epa.gov/iaq/molds/mold_remediation.html

Picture 1

Ceiling-Mounted Univent

Picture 2

Air Intake for Ceiling-Mounted Univent

Picture 3

Air Intake for Wall-Mounted Univent

Picture 4

Ceiling-Mounted Exhaust Vent

Picture 5

Wall-Mounted Exhaust Vent

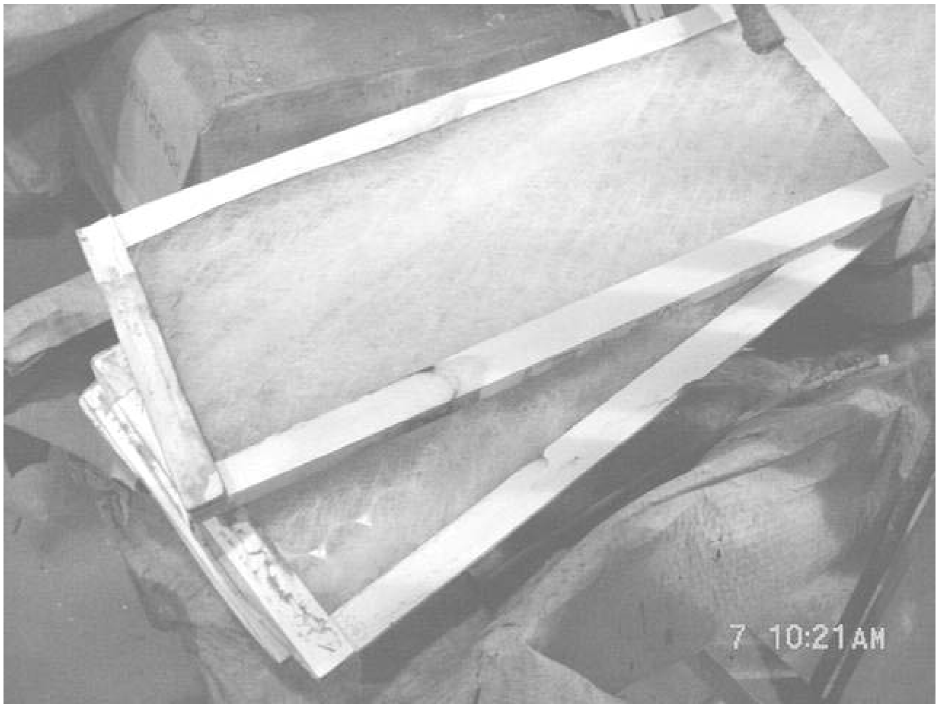
Picture 6

Window-Mounted Air-Conditioner

Picture 7

Water Damaged Cardboard Boxes in Mechanical Room

Picture 8



Water Damaged Cardboard Univent Filters in Mechanical Room

Picture 9

Trees/Shrubbery in Close Proximity to Exterior Brick

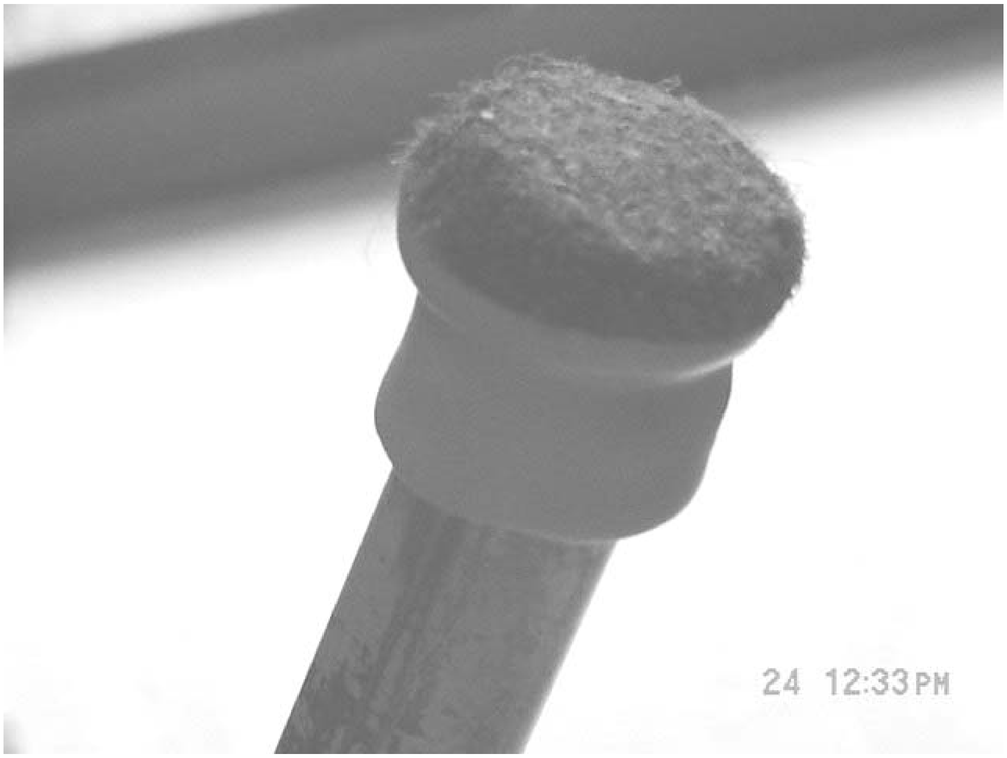
Picture 10

Tennis Balls on Walker Legs

Picture 11

Snow Blower near Clinical Office Air Intake

Picture 12



“Glides” for Chair Legs that can be used as an Alternative to Tennis Balls

TABLE 1

Indoor Air Test Results – Hogan Regional Center, 2 Hawthorne Circle, Danvers, MA July 7, 2004

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
Outside (Background)	420	86	62	-	-	-	-	Partly cloudy, winds light and variable
Break Room	777	79	56	2	N	N	Y	
Basement Hallway								Black stain possible mold on pipe lagging
Clinical Office	707	76	62	10	Y	Y	Y Off	2 ceilings, MTD univents (off) Snow blower, tennis balls on walker legs, photocopier
Laundry	531	78	62	0	N	N	Y	Former rest room, exhaust vents off; floor drain
Dryer Room (Laundry)	468	78	60	0	N	Y	Y	Local exhaust vents (2); stand up fans; local exhaust "noise", recommend variable speed dial;
Mechanical Room								Water damaged cardboard boxes containing filters-rec discarding

*** ppm = parts per million parts of air**

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 1

Indoor Air Test Results – Hogan Regional Center, 2 Hawthorne Circle, Danvers, MA July 7, 2004

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
G-7 Storage	512	77	51	1	N	Y	Y	Local supply and exhaust on opposite walls; historic signs of water penetration at SE corner – Dry after (several days of heavy rain); possible mold on walls, ceiling, in corners – concrete; mold on pipes and elbows
125 Dorm	1123	75	54	7	Y	Y	Y	
127	1159	74	54	10	Y	Y	Y	
118	598	73	47	0	Y	N	Y	2 portable AC, no draw
117	889	75	61	3	Y	N	N	Personal fan, window open
112 Director's Office	529	78	62	1	Y	N	N	Personal fan, window open
109	526	76	58	0	N	N	n	AC in window; rec oper. On fan
Nurses' Station	944	76	47	1	N	Y	Y	Doors undercut, exhaust off

*** ppm = parts per million parts of air**

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TABLE 1

Indoor Air Test Results – Hogan Regional Center, 2 Hawthorne Circle, Danvers, MA July 7, 2004

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
101	962	73	43	6	Y	Y	Y	
102	922	70	41	9	Y	Y	Y	Exhaust off
151	763	72	48	6	Y	Y	Y	Exhaust off

*** ppm = parts per million parts of air**

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred 600 - 800 ppm = acceptable > 800 ppm = indicative of ventilation problems
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Appendix A

The Commonwealth of Massachusetts
Executive Office of Health and Human Services
Department of Public Health
250 Washington Street, Boston, MA 02108-4619

August 10, 2004

Linda Montminy, Facilities Director
Department of Mental Retardation
Northeast Region Hogan Regional Center
P.O. Box A
Hathorne, MA 01937

Dear Ms. Montminy:

The Massachusetts Department of Public Health (MDPH), Center for Environmental Health (CEH), Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air quality concerns at the Hogan Regional Center (HRC), 2 Hathorne Circle, Village of Hathorne, Danvers, Massachusetts. Concerns of microbial growth on building materials in the basement prompted the request.

On July 7, 2004, a visit to conduct an indoor air quality assessment was made to this building by Cory Holmes, an Environmental Analyst in BEHA's Emergency Response/Indoor Air Quality (ER/IAQ) Program. Robert Hyde, Director of Core Services, HRC, accompanied Mr. Holmes during the assessment. The following letter details mold growth conditions observed in the basement storeroom. A full report of BEHA's general indoor air quality assessment of the building is expected to follow.

Throughout the storeroom, large portions of pipe insulation, as well as concrete ceilings and walls were observed colonized with mold (Pictures 1 to 3). In order for building materials to support mold growth, a source of water exposure is necessary. Identification and elimination of the source of water moistening building materials is necessary to control mold growth. In this case it appears that the source of moisture damaging pipe insulation is likely to be the chronic dampness and humidity that preceded the installation of mechanical ventilation. Ventilation in the basement storeroom is provided by a local exhaust fan mounted in the exterior wall and a passive supply vent on the opposite wall, for make up air (Pictures 4 and 5). Mr. Hyde reported that these vents were installed approximately twelve years ago.

The US Environmental Protection Agency (US EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Cleaning cannot adequately remove mold growth from water damaged porous materials. The application of a mildewcide to mold contaminated, porous materials is not recommended. Considering the building's age, the pipe insulation is most likely an asbestos containing material. For that reason, water damaged sections of mold colonized pipe insulation should be remediated in conformance with all applicable Massachusetts asbestos abatement and hazardous materials disposal laws.

Due to the extent of mold contamination, a professional mold remediation firm should be contacted to conduct remediation. In order to prevent potential mold and related spore movement and to reduce contaminant migration to adjacent areas during remediation, the following recommendations should be implemented.

1. Temporarily relocate materials stored in the basement during remediation activities (Picture 6). Discard porous materials (e.g., boxes, papers, files) that are deemed unworthy of preservation, restoration or transfer to another media (e.g., microfiche or computer scanning). Where stored materials, such as medical records, are to be preserved, restored or otherwise handled, an evaluation should be conducted by a professional book/records conservator. The preservation/restoration process can be rather expensive and may be considered for conservation of irreplaceable documents that are colonized with mold. Due to cost of conservation, disposal or replacement of moldy materials may be the most economically feasible option.
2. Remove all mold-contaminated materials in accordance with *Mold Remediation in Schools and Commercial Buildings*, published by the US EPA (2001). The document is available at the US EPA website: http://www.epa.gov/iaq/molds/mold_remediation.html.
3. Remediate any mold colonized asbestos containing building materials in conformance with all applicable Massachusetts asbestos abatement and hazardous materials disposal laws.
4. Use local exhaust ventilation (e.g., exhaust fans) and isolation techniques (e.g., airtight barriers) to control remediation pollutants. To prevent migration of airborne particulates into adjacent areas of the building, place the area to be remediated under negative pressure in relation to occupied areas.
5. Seal open utility holes in exterior walls and ceilings to prevent the migration of particulates and odors to occupied areas.
6. Disinfect non porous materials (e.g., door frames, cement, metal surfaces) with an appropriate antimicrobial agent. Following disinfection, non-porous surfaces should be cleaned with soap and water. Once the second cleaning occurs, use fans or dehumidifiers to dry the cleaned area as soon as possible.

Appendix A

We suggest that the majority of these steps be taken on any remediation/renovation project within a public building. Please contact us at (617) 624-5757 for further information or technical assistance.

Sincerely,

Suzanne K. Condon, Associate
Commissioner
Center for Environmental Health

Enclosure

cc:	Mike Feeney, Director, Emergency Response/Indoor Air Quality, BEHA

Appendix A

References

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Appendix A

Picture 1

Mold-Colonized Pipe Insulation in Basement Storeroom

Appendix A

Picture 2

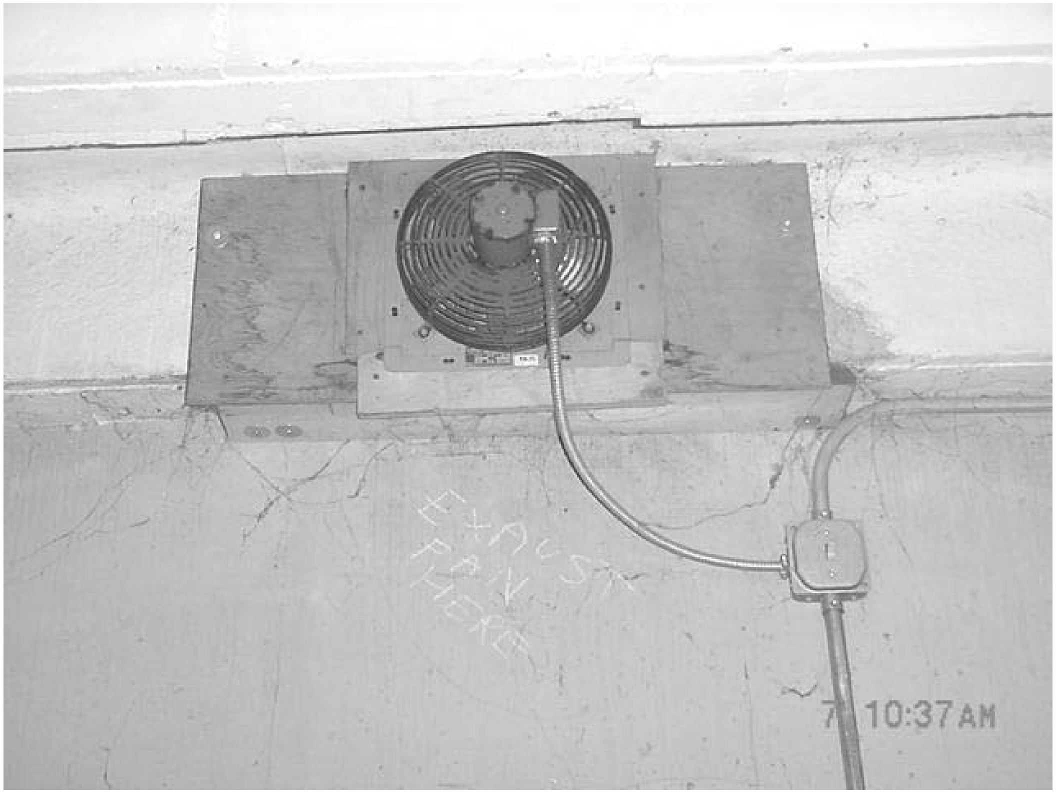
Mold-Colonized Pipe Insulation in Basement Storeroom

Picture 3

Mold-Colonized Concrete Walls and Ceiling in Basement

Appendix A

Picture 4



Local Exhaust Fan in Basement Storeroom

Picture 5

Supply Vent for Make-Up Air in Basement Storeroom

Picture 6

Materials in Basement Storeroom